Optimal Merging of AMSR-E Snow Water Equivalent and MODIS Snow Cover Observations Through Data Assimilation

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Project Abstract

We propose to develop and test a technique for optimally merging snow observations from multiple observing systems into high resolution global land surface models. With this assimilation technique, we will generate spatially and temporally continuous global snow water equivalent fields from Terra/Aqua MODIS snow cover and Aqua AMSR-E snow water equivalent observations. These assimilated fields will be useful, for example, for improving initial conditions for numerical weather and climate prediction model simulations and input to spring melt water and river flow forecasting systems as well as for investigating large scale aspects of the Earth's energy and water cycles. MODIS based snow cover, AMSR-E based snow water equivalent, and land surface model snow water equivalent estimates each have distinct advantages and disadvantages. MODIS can provide daily, global, high resolution maps of snow cover, but not water equivalent, limited to cloud-free daytime conditions. AMSR-E can be used to infer snow water equivalent day or night, but significant errors arise where the snow is very deep or wet and in densely vegetated areas. Land surface model snow fields are spatially and temporally continuous, but their accuracy is limited by the quality of the input forcing data (such as precipitation and radiation) and by the simplifying assumptions of the model.

We will design and test several innovative data assimilation techniques for synthesizing the MODIS and AMSR-E observations with our knowledge of physical processes, as embodied in land surface models, in order to generate snow fields that are spatio-temporally continuous and rooted in reality. The proposed algorithm is a **superior approach** that **(i)** is based on the joint assimilation of snow cover and SWE observations, **(ii)** uses global SWE retrievals from satellite (in addition to sparse in situ SWE measurements), **(iii)** incorporates improved error estimates for snow observations, **(iv)** dynamically propagates estimated model error for snow states within a Kalman filtering framework, and **(v)** minimizes adverse effects on the water balance. Results will be compared with existing analysis products and validated using ground based measurements from observation networks and field experiments.